Mycobacterium, except that there is no evidence of the fixation of nitrogen. Hitherto pure cultures of *Ardisia* have been unobtainable.

VON FABER[13] very recently has published further, checking up various minor points, and discussing MIEHE'S work and his criticisms of the work of VON FABER. The most noteworthy result recorded in the latest paper is the success of the attempt to synthesize pure cultures of *Pavetta* and *Mycobacterium*. A symbiosis of the usual kind seen in nature resulted from the inoculation of the former by the latter. The luxuriant cultures thus arising seem to show clearly that VON FABER was working with the proper symbionts.—H. C. COWLES.

Stomatal activity.—ILJIN[14] has found that when the stomates of *Centaurea orientalis* are open, the guard cells have an osmotic pressure ranging from 85 to 108 atmospheres. When the stomates are closed, the guard cells have an osmotic pressure of 13–20 atmospheres. The osmotic pressure of the epidermal and parenchyma cells of the leaves vary little and approximate that of the guard cells with the stomates closed. Similar results were obtained for *Senecio Doria*, *Iris pumila*, *Eryngium campestre*, *Verbascum Lychnitis*, *Veronica incana*, and others. The guard cells with high osmotic pressure (stomates open) contain no starch, while the guard cells of low osmotic pressure (stomates closed) bear an abundance of starch. Conditions that bring about the closure of the stomates, darkness or excessive transpiration, will produce the condensation of the sugar to starch, accompanied by the great fall in osmotic pressure in about two hours. The reverse process of hydrolysis, accompanied by the great rise of osmotic pressure and opening of the stomates, is accomplished in about the same time under illumination and low evaporation power of the air. If these results are correct, we have here a great contribution to the mechanics of stomatal regulation. One would like to know the variation in the osmotic pressure of guard cells that show little stomatal regulation, as is true of certain swamp and xerophytic forms.

ILJIN[15] has also made an extensive study on stomatal regulation of transpiration. He used cuttings of plants in potometers and calculated the transpiration on the basis of the grams loss of water per 1000 $cm.^2$ per hour. While the potometer measures water absorption rather than loss, he believes that the two quantities are essentially equal in his work, since he has always discarded experiments in which wilting became noticeable. He ran his experiments in the open, either in an exposed place (the steppe) or in a protected region

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[13] VON FABER, F. C., Die Bakteriensymbiose der Rubiaceen (Erwiderung und ergänzende Mitteilungen). Jahrb. Wiss. Bot. **54**:243–264. *figs. 3.* 1914.

[14] ILJIN, W. S., Die Regulierung der Spaltoffnung im Zusammenhang mit der Veränderung des osmotischen Druckes. Beih. Bot. Centralbl. **32**:15–35. 1914.

[15] ———, Die Probleme des vergleichenden Studiums der Pflanzentranspiration. Beih. Bot. Centralbl. **32**:36–65. 1914.

(the ravine). On the steppe, *Sanguisorba officinalis* transpired more rapidly than *Clematis integrifolia*, 3.3 gm. against 1.2 gm. In the ravine the reverse was true, 1.7 gm. against 0.7 gm. Similar results were found for *Phlomis pungens* and *Ajuga Laxmanni*, with the former transpiring more rapidly in the steppe and less rapidly in the ravine. These facts are explained by the rapid closure of the stomates of *Sanguisorba* and *Ajuga* in the exposed position, and the slow closure in the other forms. In another experiment, two marked xerophytes, *Aster villosa* and *Veronica incana*, showed much higher transpiration than two evident mesophytes, *Aristolochia clematitis* and *Sanguisorba officinalis*. The losses in these forms were respectively 43.3, 15, 11.3, and 6.4 gm. These results are explained by the stomates being closed in the mesophytes and open in the xerophytes.

It was rather a common thing to find higher transpiration in a given mesophyte in the ravine than on the steppe, owing to the stomatal closure in the latter place. In *Ajuga Laxmanni*, there were 10.5 gm. on the steppe against 26.2 gm. in the ravine; in *Centaurea orientalis*, 17.6 gm. against 31.5 gm. In an experiment with *Helianthus annuus*, *Pisum sativum*, *Vicia Faba*, and *Polygonum fagopyrum* placed in a series of positions where the evaporation power of the air graded from a low value to a high, the transpiration rose with the evaporation power of the air up to a certain height, then it fell enormously with the rise of the evaporation power of the air. The break was the point at which stomatal closure was induced. When the author started with various mesophytes and xerophytes, all with the stomates open, and placed them in conditions where the evaporation power of the air was rather high and rising rapidly, as time elapsed the mesophytes showed rapid transpiration, rising rapidly with the evaporation power of the air for two hours or so, followed by a rapid fall. In this case there is a high and sharp pointed curve. The xerophytes showed slower initial transpiration, a far slighter rise with the evaporation power of the air, and no such marked fall. In this case, the curve is flat, with no very high or sharp point. ILJIN believes the two types of curves represent mesophytism on the one hand and adaptation for xerophytism on the other. The xerophyte can protect itself against excessive transpiration in exposed positions without curtailing extremely the CO_2 necessary for carbon assimilation by rapid or extreme stomatal closure. This work indicates the great importance of stomatal variation in regulating transpiration, especially in mesophytes, a conclusion quite in contrast with that of LLOYD.—WILLIAM CROCKER.

Alpine plant-geography.—RYDBERG,[16] in the first three of a series of articles on the phytogeography of the Rocky Mountain region, has discussed the alpine zone, its environmental conditions, geographic floristics, and plant

[16] RYDBERG, P. A., Phytogeographical notes on the Rocky Mountain region. I. Alpine region; II. Origin of the alpine flora; III. Formations in the alpine zone. Bull. Torr. Bot. Club **40**:677–686. 1913; **41**:89–103, 459–474. 1914.